Sedentary behaviour, physical activity, and fitness

Valorisation addendum

Main responsibilities of Dutch universities include education, conduction of scientific research, and the transition of knowledge to society; valorisation. Knowledge valorisation is defined as the process of creating value from knowledge, by making knowledge suitable or available for social (and economical) use and by making knowledge suitable for translation into products, services, processes and new commercial activities.[1] This addendum describes the potential benefits of the present thesis on society.

Why are the results from this thesis relevant?

Currently, our society is faced with an ageing population, in which the prevalence of cardio-metabolic diseases (e.g. cardiovascular disease and type 2 diabetes) and limitations in physical function is increasing. These adverse health conditions not only pose a burden on patients, but also on society due to elevated costs of health care and loss of production. From a public health perspective, delaying the onset or preventing these conditions is desirable.

As described in this thesis, one of the key modifiable determinants of adverse health is physical inactivity. In particular the role of higher intensity physical activity (HPA) has been examined extensively. People who engage more often in HPA have a lower risk of developing cardio-metabolic diseases and functional limitations. In addition, engaging in HPA is related with better cardio-respiratory fitness, which in itself is a strong health predictor. More recently, studies show that also activities of lighter intensity may improve health. In addition to physical activities, the role of sedentary behaviour (any waking behaviour characterized by low energy expenditure) needs to be addressed. An increasing number of studies have associated sedentary behaviour with adverse health conditions. A large amount of daily sedentary behaviour (sitting), independent of the amount of HPA, has been associated with cardio-metabolic diseases and mortality.

However, questions regarding the health effects of sedentary behaviour remain. For instance, is sedentary behaviour associated with lower CRF and lower physical function, independent of HPA? If so, this may provide new strategies to prevent functional limitations. Further, if a person has a high CRF, is sedentary behaviour still a risk for cardio-metabolic health? Possibly, not everyone may benefit from reductions in sedentary behaviour. Furthermore, what is more strongly associated with cardio-metabolic heath: sedentary behaviour, HPA or CRF? Additional insight into sedentary behaviour, HPA, and CRF and their interrelationship as risk factors for cardio-metabolic health may help to expand public health messages and policies aimed at preventing cardio-metabolic diseases.

What can we learn from these results?

Results in this thesis add to the current literature and show that physical activity, in particular HPA, is an important determinant of cardio-metabolic health (chapters 4-7), CRF (chapter 3) and physical function (chapter 2). Further, results in this thesis showed that sedentary behaviour is associated with cardio-metabolic health and CRF, even when adjusted for HPA (chapters 5 and 6). This implies that reducing the amount of sedentary time could lead to improved cardio-metabolic health.

In addition to daily activities, this thesis focused on CRF as determinant of cardio-metabolic health. CRF was even more strongly associated with cardio-metabolic health than HPA (chapter 5). Thus, sub-maximal exercise testing, such as performed in the present thesis, provides important insight to predict future health problems. Therefore, it could be argued that CRF should be incorporated in the evaluation and management of cardio-metabolic disease risk and "low CRF" should be considered as a condition that requires treatment.[2]

For whom may these findings be relevant?

In a clinical setting, increasing physical activity has been used as an intervention to improve cardio-metabolic health for many years. In addition to physical activity, reducing the amount of daily sedentary time should be regarded as potential intervention to improve health. Results from our studies (chapters 3, 5 and 6) and others have demonstrated that reducing the amount of sedentary time may improve cardio-metabolic health. Thus, physicians should encourage patients to sit less. However, at this time specific recommendations on the amount of sedentary time to decrease are difficult to make. The importance of regular physical activity and sedentary behaviour should also be addressed in many other settings: environmental, school, work.

The population should have easy access to an environment that stimulates physical activity and dissuades from sitting too much. For instance, parks and recreational areas with public sport facilities (football fields, skate parks etc.) may stimulate physical activity. In addition, promoting active transport (e.g. by building bike lanes and foot paths) seems a powerful strategy to stimulate physical activity.[3] Employers could provide their employees with more options to reduce the amount of sedentary time during working hours. Examples are stand- or cycling work stations and standing or walking meetings. These things have been implemented on a small scale and show promise in reducing the amount of sedentary time during working hours.[4] Results from chapter 6 indicate that replacing 30 minutes of sedentary time per day with other activities was already associated with improved cardio-metabolic risk markers. In addition to potential health gain, standing and walking during meetings appears to increase efficiency.

Children and adolescents require more physical activity than adults. Therefore, it is important that they are stimulated to be physically active. For instance, on school days, students should be encouraged to go outside and play during breaks. In addition, more gym classes could be scheduled. It is important to stimulate physical activity during youth/adolescence as physical activity levels at this age may track into adulthood.[5]

Up-to-date, science-based physical activity guidelines, such as recently proposed by the Dutch health council (Gezondheidsraad), are needed to stimulate physical activity in all the settings described above. These

What's next?

The results from this thesis may stimulate new research projects. As mentioned in the general discussion, results from this thesis are limited by the cross-sectional analyses; sedentary behaviour, physical inactivity and low CRF may (partly) be the product of poor health. Therefore, causality should be determined in longitudinal studies. Longitudinal data on sedentary behaviour and mortality is available for NHANES, but the period of follow-up is relatively short.[6] In particular, longitudinal results from The Maastricht Study may provide valuable insight into the causality of sedentary behaviour as sedentary behaviour is accurately captured by the posture based activity monitor.

Second, dose-response effects should be studied. This can be done in an observational setting, but also in an experimental setting. These studies should explicate how much sitting is too much and how much physical activity do we need in order to remain in good health? Do we need to engage in physical activity throughout the day, or are a few longer bouts of physical activity per week sufficient? At what intensity should this physical activity be performed? Should we really avoid long bouts of uninterrupted sitting? This type of information is crucial to develop targets for interventions. In chapter 6 we demonstrated that theoretically replacing 30 minutes of sedentary time with standing was already associated with lower risk of having the metabolic syndrome and T2DM. However, will similar effects also be observed in an experimental setting? Further, results from chapter 5 suggest that a shift from low CRF to medium CRF is associated with greatest reduction in the likelihood of having the metabolic syndrome and type 2 diabetes. An increase in CRF may already be achieved by substituting sedentary time for light intensity physical activities (chapter 3), but will this indeed result in markedly improved CRF?

Finally, we must examine the feasibility of changes in daily activities and CRF. What amount of sedentary time can be reduced and how much can physical activity be increased? Importantly, can improvements in the balance of daily activities be sustained

over a longer period of time? Consumer-based wearable activity monitors (such as the Fitbit and Jawbone) and applications on smartphones, may aid individuals in sustaining an acquired healthy activity pattern.

All this (future) work will contribute to a better understanding of the health consequences of physical activity and sedentary behaviour. Physical activity guidelines, such as implemented by the WHO may require updates when our knowledge in this field progresses.

References

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